

CLAIMS

What is claimed is:

1. A computer controlled method for evaluating selected surface and physical optical properties of structures made wholly or partly from
5 fibers, polymers, films or a combination thereof, said method comprising the steps of:
 - (a) illuminating the surface of a structure;
 - (b) obtaining a digitized image from the illuminated surface of the structure; and
 - 10 (c) computer processing of the digitized image to determine a property of the structure selected from the group consisting of:
 - (1) a fiber orientation distribution (ODF) of the fibers on the surface of the imaged structure; (2) basis weight non-uniformity (blotchiness) of the structure; (3) pilling on the surface of the
 - 15 structure; and (4) texture function of the structure.
2. The method according to claim 1 including illuminating the surface of a structure with a direct, collimated, dark-field, or coaxial light source.
- 20 3. The method according to claim 1 including obtaining a digitized image from the illuminated surface of the structure with a camera.
4. The method according to claim 1 including creating a fiber orientation distribution (ODF) of fibers on the surface of a structure selected from

the group comprising nonwovens, paper and their respective composites.

- 5 5. The method according to claim 4 including processing of the ODF to rank the ODF against known standards.
- 10 6. The method according to claim 1 including measuring basis weight or structure non-uniformity (blotchiness) of a structure selected from the group comprising webs; papers; and nonwovens and composites made from one or more of these materials.
- 15 7. The method according to claim 6 including processing of the basis weight non-uniformity against known standards.
- 20 8. The method according to claim 1 including determining pilling on the surface of a structure selected from the group comprising woven and knit constructions.
9. The method according to claim 8 including processing of surface pilling against known standards.
10. The method according to claim 1 including determining texture function of a structure selected from the group comprising woven, knit and non-woven constructions.

11. The method according to claim 10 including processing of the texture function against known standards.
12. A computer controlled method for evaluating selected surface and physical optical properties of structures made wholly or partly from fibers, polymers, films or a combination thereof, said method comprising the steps of:
 - (a) illuminating the surface of a fibrous structure;
 - (b) obtaining a digitized image from the illuminated surface of the structure; and
 - (c) computer processing of the digitized image including use of at least one algorithm selected from the group comprising: Fourier transform; hough transform; direct tracking; ridge tracking; edge tracking and flow filed analysis to create a fiber orientation distribution (ODF) of the fibers on the surface of the imaged fibrous structure.
13. The method according to claim 12 including illuminating the surface of a fibrous structure with a direct, collimated, dark-field, or coaxial light source.
14. The method according to claim 12 including illuminating the surface of a fibrous structure by transmitting light from a light source through a diffuser and a beam splitter onto the fibrous structure supported by a

mirror therebeneath to facilitate obtaining the digitized image by a camera positioned above the fibrous structure.

15. The method according to claim 12 including obtaining a digitized image
5 from the illuminated surface of the structure with a camera.
16. The method according to claim 12 including computer processing of the
digitized image with a Fourier transform algorithm to create a fiber
orientation distribution (ODF) of the fibers on the surface of the imaged
10 fiber structure.
17. The method according to claim 12 including creating a fiber orientation
distribution (ODF) of fibers on the surface of fibrous structure selected
from the group comprising non-wovens, paper and their respective
15 composites.
18. The method according to claim 13 including processing of the ODF to
rank the ODF against known standards.
- 20 19. A computer controlled method for evaluating selected surface and
physical optical properties of structures made wholly or partly from
fibers, polymers, films or a combination thereof, said method comprising
steps of:
 - (a) illuminating the surface of a fibrous structure;

- (b) obtaining a digitized image from a structure sample size of at least $10 \times 10 \text{ cm}^2$; and
 - (c) computer processing of the digitized image including breaking the digitize image into windows of at least $1 \times 1 \text{ cm}$ for analysis of size effect in order to determine basis weight non-uniformity (blotchiness) of the fibrous structure.
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- 20. The method according to claim 19 including illuminating the surface of the structure with a direct, collimated, dark-field, or coaxial light source.
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- 21. The method according to claim 19 including illuminating the surface of the fibrous structure by transmitting light from a light source through a diffuser and a beam splitter onto the fibrous structure supported by a mirror therebeneath to facilitate obtaining the digitized image by a camera positioned above the fibrous structure.
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- 22. The method according to claim 19 including measuring basis weight or structure non-uniformity (blotchiness) of a structure selected from the group comprising webs; papers; nonwovens and composites made from one or more of these materials.
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- 23. The method according to claim 22 including processing of the basis weight non-uniformity against known standards.

24. A computer controlled method for evaluating selected surface and physical optical properties of structures made wholly or partly from fibers, polymers, films or a combination thereof, said method comprising the steps of:

- 5 (a) circularly illuminating the surface of a fibrous structure having pilling thereon by transmitting light at an acute angle of between about 4° and 60° to the surface of the structure to provide dark field imaging of the surface structure wherein little light is reflected by the surface and significant light is reflected by pills
- 10 and surface defects thereon;
- (b) obtaining a digitized dark field image of the surface of the structure; and
- (c) computer processing of the digitized image to determine pilling on the surface of the structure.

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25. The method according to claim 24 including illuminating the surface of the structure with a direct, collimated or dark-field transmitted light source.

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26. The method according to claim 24 including the determining pilling on the surface of a structure selected from the group comprising woven and knit constructions.

27. The method according to claim 26 including processing of surface pilling against known standards.
28. A computer controlled method for evaluating selected surface and physical optical properties of structures made wholly or partly from fibers, polymers, films or a combination thereof; said method comprising the steps of:
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- (a) illuminating the surface of a fibrous structure by transmitting light at a acute angle thereto between about 10° and 80° in order to highlight raised features on the surface of the structure;
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- (b) obtaining a digitized image of the structure of the surface; and
- (c) computer processing of the digitized image including use of an algorithm to determine texture periodicity and corresponding amplitude in order to determine the texture function of the structure.
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29. The method according to claim 28 including illuminating the surface of the structure with a direct, collimated or dark-field transmitted light source.
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30. The method according to claim 28 including computer processing of the digitized image with a Fourier transform (FT) to determine the texture function of the substrate.

31. The method according to claim 28 including computer processing of the digitized image with a co-occurrence method to determine the texture function of the substrate.
- 5 32. The method according to claim 30 and 31 including computer processing of the digitized image with a Fourier transform (FT) method to determine the texture index or fingerprint of the substrate.
- 10 33. The method according to claims 28 including determining texture function of a structure selected from the group comprising woven, knit and non-woven constructions.
34. The method according to claim 33 including processing of the texture function against known standards.